

AGARICUS - MONTANA

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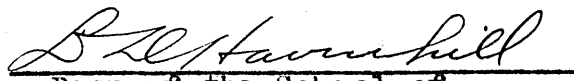
Charles Edwin Francis Mollett

Ph.C., '04 Kansas, A.B. '20 Montana

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Instructor in Charge

  
Dean of the School of  
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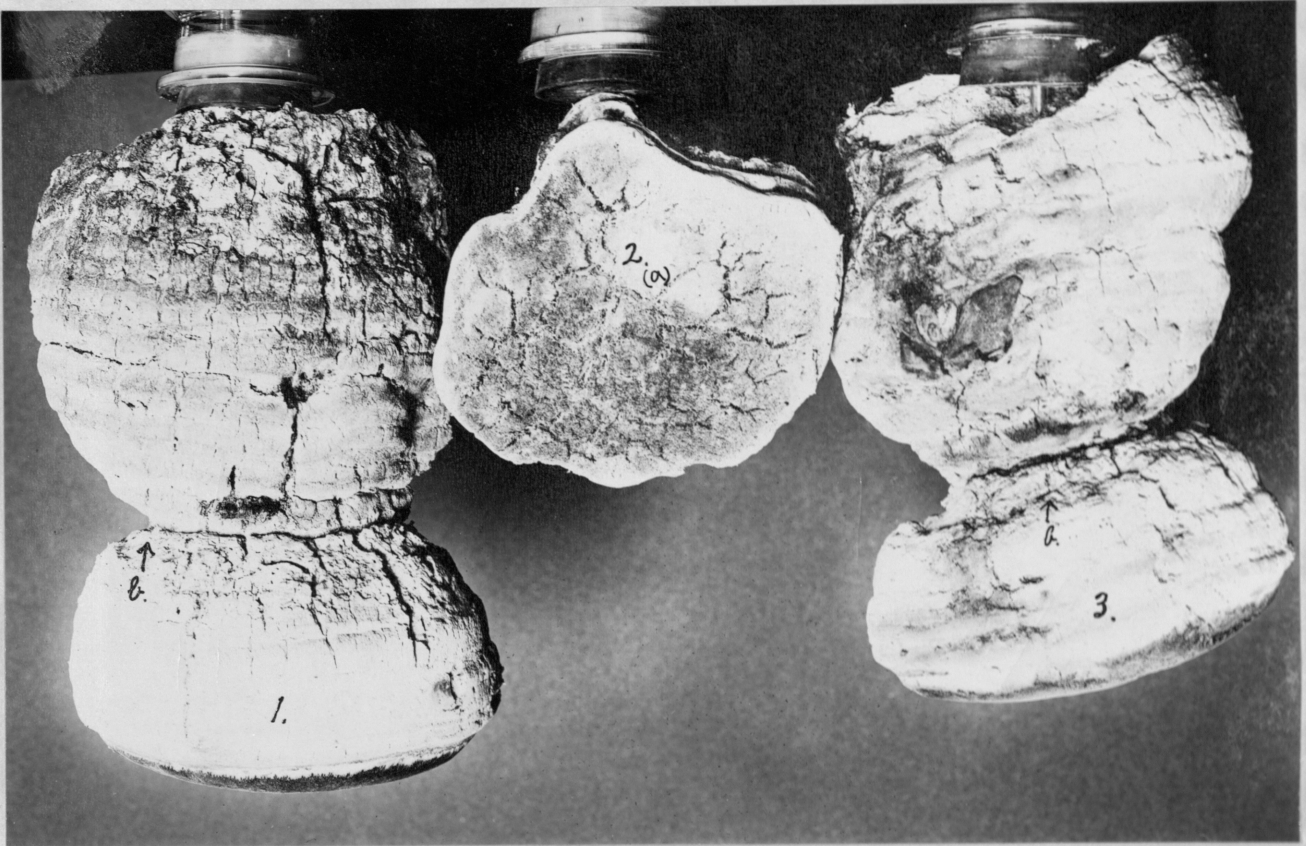
## C O N T E N T S

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PLATE I.

Fig. 1, 2, and 3.



TYPICAL FRUITING BODIES OF AGARIC  
FROM THE BLACKFEET FORESTS OF MONTANA

Fig. 1 and 3, lateral view and in the position in which they occur upon the trees, show constrictions (b) in the bodies. Fig. 2 shows the hymenium, (a) or lower surface containing the openings of the long slender pores.

## A G A R I C

### Botanical, Chemical, and Pharmacodynamic Study of Montana Agaric.

#### I. Introduction.

More than a decade ago the author became interested in the economic problems of determining what medicinal products might be obtained from Montana as a source of supply for use of the Department of Pharmacy and also for commercial uses in case the nation should be called upon to be self supporting in medicinal products. It was also deemed desirable to know, from a pharmacy standpoint, what drugs, if any, could be profitably gathered in the state, which altogether lead to a close study and observance of the plant life.

Agaric was therefore observed growing upon the larch tress of the Blackfeet forests near Belmont Creek, about forty miles from Missoula in 1916, and was later found in other localities in the national forests of western Montana. The fungus was known at that time in the botanical and forestry literature of the United States as *Fomes laricis* and *Fomes officinalis*. It was therefore advisable to establish its identity and to prove it to be the same plant as that producing the drug recognized in medical and pharmaceutical literature as *Polyporus officinalis*, Family *Pinaeaceae* (Fries), and to compare the constituents and medicinal qualities of the fruiting body with those of the drug coming from foreign sources.



## II. History and Geographical Distribution.

The fruiting body of *Fomes laricis* was known and used as a medicine from the time of Dioscorides, as well as by the herbalists of the middle ages. It was reported to be found only upon the larch in southeastern Europe, northern Russia, Siberia, and Asia Minor. It was first described by Dioscorides about 60 A. D., and he states that it was imported from Agaria in southern Russia, from whence it received its official Latin name (8). More recent investigators report its occurrence in western America from British Columbia to Central America on larch, yellow pine, fir, and spruce (1) (33). It is quite common in Montana in some localities in the Blackfeet and Flathead forests on trunks of old living trees of Western Larch.

## III. Description of the Larch Host.

Two species of larch are found growing in Montana: *Larix Lyalli* and *Larix occidentalis*. The former is found growing only sparsely in this state at very high altitudes, and was not found to be infested with the fungus. The latter species, which is commonly known as Western Larch or Tamarack, is found more abundantly and seems to be the preferred host of the fungus.

The Western Larch or Tamarack is one of the largest of the native western trees and in comparison with the other pines has a much larger quantity of heart-wood and a very thin shell of sap-wood, which makes it more adaptable for heart-rotting fungi. It develops a straight tall stem and often reaches a height of 200 feet with a diameter of from five to six feet at the butt.

The average maximum height is about 175 feet. The oldest trees on record are said to be about 700 years, the average being about 400 years. It is a rapidly growing tree, growing on an average of thirty inches a year. It grows chiefly in the drainage of the upper Columbia River and its natural range extends from southern British Columbia to the western slope of the Continental Divide of northern Montana and to the eastern slopes of the Cascade Mountains of Oregon. In Montana it is found west of the Continental Divide from Canada to about fifteen miles south of Missoula, while it occurs in all of the national forests in Idaho north of the Salmon River. It seems to prefer western and northern exposures on mountain slopes, stream bottoms, valleys, and flats at elevations between 2000 and 7000 feet. It reaches its best development in northwestern Montana, northeastern Washington, and northern Idaho (39). It is in these localities, and especially in Montana, where the Agaric is most often found using it as its host.

#### IV. Nomenclature and Description of the Fruiting Body.

The fruiting body or conk is usually erroneously spoken of as the fungus, since the sporophores or fruiting bodies are the parts of the fungus that are official. They are found in numbers of from one to half a dozen at heights varying from 0.9-15 M. (3-50 ft.) upon the same tree. The size and number of the fruiting bodies give a fair indication of the extent of the growth in the heart-wood of the tree. The botanical name of the fungus in medical literature is *Polyporus officinalis*

and the following references are found in botanical literature:

*Fomes Laricis* (Jacq.) Murril, Bull. XX Torrey Club 30: 230, (1903) is a member of the Polyporaceae Family. Its botanical synonyms are *Boletus Laricis* (Jacq.) Misc. Austr. 1:64, (1778); *Boletus officinalis* (Viii.) Hist. Pl. Dauph. 3:1041: 789; *Boletus Purgans* (Pers.) Syn. Fung. 531, 1801; *Polyporus officinalis* (Fries) Syst. Myc. 1:365, 1821; *Fomes Albogriseus* (Peck) Bull. Torrey Club 30:97, 1903.

It is a perennial fungus plant and one of the heart-rotting fungi, also known as a wound parasite as it gains entrance to the tree through the heart-wood exposed by wounds and burns or through broken off limbs, the mycelium or plant proper growing rapidly through the entire heart-wood of the tree, replacing the cell wall with fine, soft, white mycelial felts. (16) (17). The fungus attacks all of the wood cells: wood tracheids, ray cells, ray tracheids, and resin cells, removing the cellulose but leaving the lignin as a brown crumbly or friable mass known as cubical heart-rot. This weakens the tree mechanically and is responsible for the loss of much valuable timber. It can be cultured easily on malt agar, from infected wood or spores. While casual observance would seem to show that it is an obligate parasite, recent researches indicate that it is wholly a saprophyte (43) (44).

The sporophore or fruiting body is a perennial growth and is produced on the outside of the tree, and is known as the conk, bell, or pileus. It is enlarged each year and grows in length

by the production of a new layer beneath; each layer being known as a sulcus and the entire body being most commonly known as the conk. The most recent sulcus, containing the long slender pores, is known as the hymenium. Plate III. The fruiting body of the fungus is described by Fries as follows: Pileus unguulate, 5 - 10x4 - 10x6 - 20 cm., white or yellowish, sometimes slightly incrustated, sulcate; context white or whitish, in mature plants friable, bitter to taste, with farinaceous odor, 2-5 cm., thick; tubes 3-8 mm.; spores ovoid, 3-4 x 4-5  $\mu$ ; cystidia none; hypae 3-5  $\mu$  (33).

*Fomes Albogriseus* is said to be a small form of *Fomes officinalis* (33).

The most common names of this official fungus that are found in botanical literature are Chalk Fungus and Quinine Chalk Fungus. Its synonyms in the National Formularies IV and V are White Agaric and Larch Agaric. In the National Standard Dispensatory, third edition, 1916, the synonyms: *Boletus*, and White, Larch or Purging Agaric are found. In the English Pharmacopoeia it is known as Larch Agaric, Male Agaric, German Tinder; in the German, *Larchen schwamm*; and in the 1920 French Codex, *Agaric Blanc Officinal*, *Polypore due Meleze*.

The National Standard Dispensatory, third edition, describes the fruit body of the fungus as a sessile, hoof-shaped or irregularly conical, 10-20 cm. (4-8 in.) broad, 5-10 cm. (2-4 in.) thick, and 20-30 cm. (8-12 in.) high; externally, grayish or yellowish. The hymenium on the lower surface is in the form of small, yellowish pores. It is collected in autumn and winter and deprived of the firm, outer rind. The N.F. V gives the following description and

physical properties on page 268:

Unground Agaric: Light, fibrous, somewhat spongy pieces of irregular shape; grayish white to pale brown externally; yellowish and resinous internally, fracture tough, fibrous; friable but difficult to powder. Odor faint; taste, sweetish, acrid and bitter.

Powdered Agaric: Numerous non-septate, narrow mycelial threads and few prismatic or cubical crystals of calcium oxalate from 0.010 to 0.040 mm. in diameter.

The species found growing in Montana and identified by the author as *Polyporus Officinalis* (Fries) produces a whitish to light yellow sessile, bell-shaped fruit body, varying from 10-20 cm. (4-8 in.) broad, from 10-20 cm. (4-8 in.) thick, and from 2-6 dm. (3/4 to 2 ft.) long, the variations depending of course upon the age and conditions of growth. It is found weighing as much as thirty pounds. (See Plate I.) Externally, it is grayish to light brown and powdery. Internally, the sulcate context is composed of non-septate, narrow mycelial threads, being white and spongy when fresh, chalky or friable when dry, bitter to the taste, with a farinaceous odor. The hymenium found on the lower surface of the bell-shaped growth is made up of numerous small, yellowish pores, 3-4 per mm., 3-10 mm. long, which contain irregular margined ovoid spores 3-4 x 4-5 $\mu$ .

The drug may be powdered when dry by rubbing upon a sieve or by using a coarse rasp. When coarsely cut and well dried, it may be powdered in the usual way. Some of the imported specimens obtained in commerce in powdered form and examined under the microscope, revealed carbonized material and wood and bark elements, indicating that they had not been peeled or properly cleaned of

charred wood and bark before being powdered.

The fruiting body of the living fungus, preferably several years old, should be gathered late in autumn at the close of the growing season, cleaned of foreign materials, coarsely divided and air dried at a moderate temperature. Dead fruit bodies which have long been exposed to the attacks of insects, vermin, and the weather should be rejected.

Information obtained from firms handling the drug reveals several methods of judging its reliability. Resinous content soluble in boiling alcohol and ash requirements are those commonly relied upon, altho some use the phosphate test also, which should always give a decided positive reaction. Information from practically all the firms handling the drug in the United States shows that the commercial supply comes entirely from foreign sources (14).

#### V. Histology of the Fruiting Body.

The conk, laterally surrounded by a hard rind, is made up of concentrically arranged sulci, each sulcus representing a year's growth and composed, with the exception of the most recent one, of a mass of fine white mycelial threads (Plate III, Fig. 1.) with prismatic or cubical crystals of calcium oxalate imbedded therein. The most recent growth, or hymenophore, is made up of long slender yellowish tubes or pores (Plate III, Fig. 2.) around the sides of which are born the many irregular surfaced ovoid spores. (Plate III, Fig. 1.) At the conclusion of the production of the spores, the pores are filled from above with mycelial threads (Plate III, Fig. 2c) and a new

hymenophore is produced beneath the old ones, the following season bearing a new crop of spores.

(Plate III. Fig. 1.)

Microscopical examinations of transverse and longitudinal sections of both foreign and domestic samples showed identical histological elements consisting of non-septate mycelial threads with cubical crystals of calcium oxalate and an occasional ovoid spore.

Select pieces of live domestic agaric were dehydrated and fixed in paraffin, cross and longitudinal sections made with the microtome, fixed upon slides with albumin water, deparaffinated with xylol, mounted in immersion oil, and photo-micrographs taken (40). Longitudinal sections showed the long pores of the hymenium in mid-season well rounded at the upper end of the pore. (See Plate III, Fig. 2).

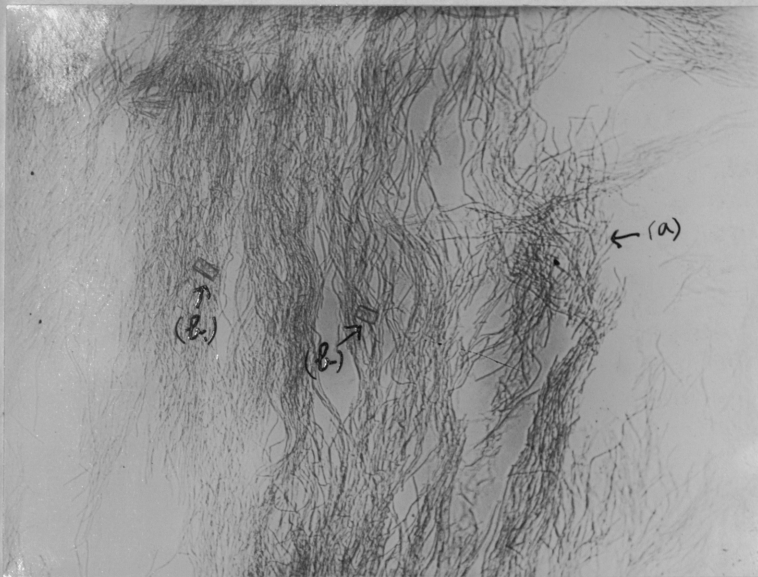
Longitudinal sections of the mymenophores of bodies gathered at the beginning of the growing season showed the upper ends of the pores being filled with a mass of fine mycelial threads. (See Plate III, Fig. 2).

Cross-sections of the hymenophores at the close of the growing season showed the circular opening of the pores with irregular ovoid spores around the inner walls of the pores. (See Plate III, Fig. 1.) Longitudinal sections of sulci of preceding years showed mycelial threads with aggregations here and there of calcium oxalate crystals varying from 0.01 to 0.04 mm. (See Plate II, Fig. 1b) .

PLATE II.

Photo-micrographs

1. Longitudinal section thru body of the fungus showing mycelial threads (a) with crystals of calcium oxalate imbedded. (b). (Under the low power of the microscope).



2. Longitudinal section thru the hymenium showing mycelial structure (a) and longitudinal openings of the pores (b) with rounded apices. (c). (Under the low power of the microscope).

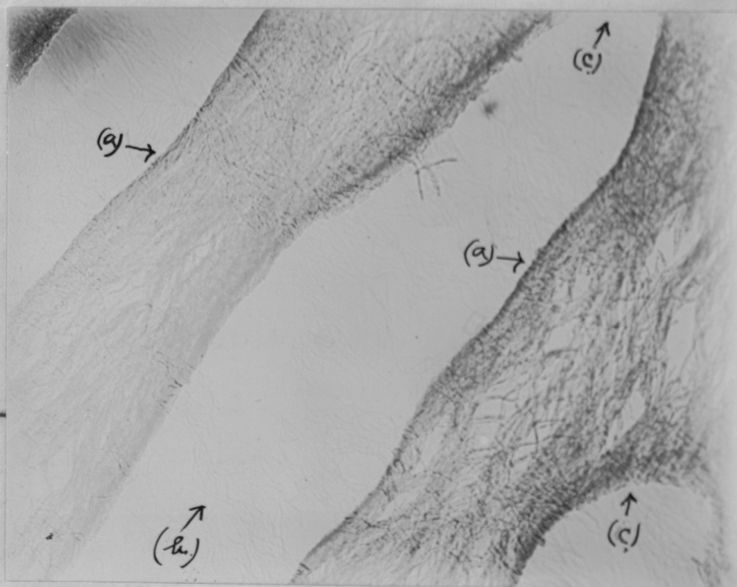
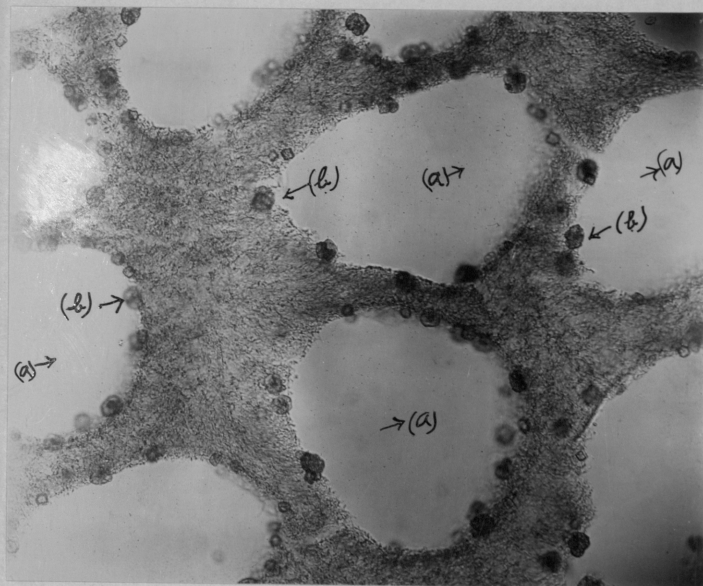




PLATE III.

Photo-micrographs



1. Cross-section of the hymenium showing circular openings of the pores (a) with spores (b) borne around the walls of the orifices of the pores. (Under the low power of the microscope.)

2. Longitudinal section of the hymenium, showing mycelial structure (a), with opening of pores (b) with the apex of the pore filling with fine mycelial threads (c). (Under the low power of the microscope.)



The crystals of calcium oxalate in the powder seen under the microscope were found to be insoluble in acetic acid, but soluble in hydrochloric acid, which proved their identity (34).

#### VI. Analyses.

The following tests were made upon foreign (imported) and domestic (Montana) samples and all determinations were computed upon the weight of air dried samples, or upon the weight of the drug as it was secured in commerce. The domestic samples for these analyses were collected in the fall, cleaned of foreign materials, and allowed to dry at a moderate temperature, ten grams of drug being used for each test.

## TABLE OF ANALYSES

Foreign Samples

			<u>Moisture</u> <u>%</u>	<u>Resins ob-</u> <u>tained by</u> <u>Hot alcohol</u> <u>%.</u>	<u>Ash %.</u>	<u>Insoluble</u> <u>Ash in 10%</u> <u>Hydrochloric</u> <u>Acid</u>
1 a	Test	Powdered	3.4	78.44	0.54	
b	"	"	3.1	78.06	0.51	
2 a	"	"	4.0	76.05	0.35	0.05
b	"	"	4.5	71.01	0.6	0.04
3 a	"	Irregular	5.5	66.0	1.4	0.08
b	"	pieces	5.3	67.5	1.7	0.09
4 a	"	"	6.1	63.0	1.8	0.13
b	"	"	5.8	60.0	1.5	0.08
		Average	<u>4.7</u>	<u>70.0</u>	<u>1.05</u>	<u>0.078</u>

Domestic Samples

14a	Test	Rasped from				
		Sample	4.7	78.0	0.5	0.06
b	"	"	5.1	74.8	0.6	0.52
18a	"	"	5.1	81.3	0.28	0.009
b	"	"	5.6	82.2	0.26	0.015
19a	"	"	4.3	77.9	0.33	0.2
b	"	"	4.5	76.0	0.34	0.24
22a	"	"	5.5	63.3	0.34	0.01
b	"	"	5.3	64.6	0.27	0.011
		Average	<u>5.01</u>	<u>74.7</u>	<u>0.38</u>	<u>0.142</u>

26a	Test	Peelings	<u>Peelings from Foreign Sample</u>		
b	"	"	5.3	62.6	1.20
			5.8	61.9	1.60
					0.66
					0.88

27a	"	"	<u>Peelings from Domestic Sample</u>		
B	"	"	4.8	79.5	0.66
			4.6	80.9	0.65
					0.019
					0.030

31a	Test	<u>Chloroform &amp; Ether Extract from Foreign Sample #1</u>		
		Imported		
		Sample	Chloroform Extracts	70.3
b	"	"	"	70.0
34a	"	"	Ether	74.0
b	"	"	"	63.9

36a	Test	<u>Chloroform &amp; Ether Extract from Domestic Sample #18</u>		
		Domestic		
		Sample	Chloroform Extracts	70.3
b	"	"	"	66.3
37a	"	"	Ether	74.2
b	"	"	"	71.1

Explanation of Table: Numbers 1 to 4 represent different foreign samples; a and b under each are tests made upon the same sample. Samples 14, 18, 19, and 22 are each different representative domestic samples, with a and b representing tests upon each respective sample. Analyses 26a, b are upon the peelings of the foreign drug, #4 and 27a, b are upon the peelings of the domestic drug #18. Analyses 31a, b and 34a, b represent chloroform and ether extracts from foreign sample #1, while 36a, b and 37a, b represent chloroform and ether extract from domestic sample #18.

Ether extract is approximately 5% less than hot alcohol, and chloroform approximately 10% less than hot alcohol.

Moisture determinations were made by drying the samples to a constant weight in an air bath at 100° C. The analyses therefore would indicate that it is not necessary that the fungus body be peeled as directed in the N.F.V, but only cleaned or rasped to get rid of foreign matter such as sand, wood, bark, and vermin infested parts. Specimens of foreign and domestic agaric which were analyzed for ash and resin content with the outer rind not removed were found to have practically the same percentages as those which had been peeled. The percentage of ash, however, was slightly increased while the resin content and moisture was slightly decreased, but leaving the percentage of resin well within that required by the N.F. V. The N.F. IV requirement of "not more than 2% ash" was omitted from the N.F. V, since specimens were rarely found with an ash content as high as 2% (14). (See pages 13 and 14.)

The hot alcoholic extract was obtained by placing ten grams of the powdered drug in a 250 cc. Erlenmeyer flask fitted with a perforated rubber cork holding an open glass tube of 6 dm. (2 ft.)

in length; the drug covered with 100 cc. of 95% alcohol and digested upon a water bath for one hour with occasional shaking. The contents transferred to a small glass percolator, allowed to drain, and percolated with hot alcohol to exhaustion; the percolate cooled to room temperature and sufficient alcohol added to make 200 cc.; well mixed and an aliquot portion evaporated on a water bath and dried in an air bath at 100° C., to constant weight.

The anhydrous ether extract was obtained by the same process, with the exception that the solvent was evaporated spontaneously and the residue dried over sulphuric acid. The chloroform extract was obtained by the same process as used for the alcohol extract, U.S.P. chloroform being used.

Ten grams of air dried drug were incinerated cautiously at red heat, tested for bases by the usual methods of qualitative analyses (36), and showed the presence of easily detectable quantities of calcium, potassium and iron and small quantities of sodium and magnesium. The portion of the ash insoluble in hot dilute hydrochloric acid was chiefly silicates. This was proven by dissolving in boiling sodium carbonate solution, precipitating with hydrochloric acid and confirmed by fusing in a bead with sodium carbonate (36.)

A quantity of marc, which had been extracted with hot alcohol, representing a definite quantity of air dried drug, was treated with hot dilute hydrochloric acid, filtered and the filtrate evaporated to dryness and heated to carbonization, and the residue extracted with hot dilute hydrochloric acid.

The solution was freed from bases (36) and an aliquot portion used for tests of the acid groups, which gave heavy precipitates for oxalates and phosphates. A definite portion of the solution above, after being freed from bases, and found to be free from silicates, was made strongly alkaline with sodium carbonate and boiled for some time, acetic acid and calcium chloride added and the oxalates filtered off, washed, dried, weighed and calculated as oxalic acid. (36) (37) (38). The average of several determinations was about 0.4 of 1%.

Phosphorus determinations were made by incinerating at white heat a definite quantity of air dried drug, the residue treated with hot dilute hydrochloric acid, the solution filtered and evaporated to dryness upon a water bath and redissolved in nitric acid. The solution warmed and the phosphorus precipitated with ammonium molybdate and the ammonium-phospho-molybdate washed, dried, weighed and calculated as phosphate, ( $PO_4$ ). (37) (38).

The average percentage of phosphorus, calculated as phosphate ( $PO_4$ ) from samples run on incineration tests was about 0.042 of 1%.

## VII. History and Uses of the Crude Drug.

One of the early uses of this drug was as a purgative (8), but its principal use more recently is anhydrotic, to check colligative sweats of phthisis and other profuse sweats following the continued use of salicylates and coal tar anodynes (28). It has been used as a moxa, by first saturating with nitre and drying. Woodsman use the fresh mycelial felts found in the infected trees for ban-

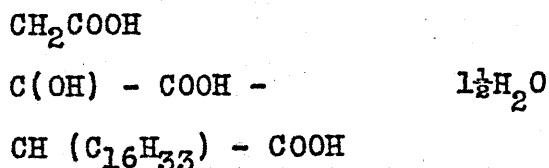
daging fresh wounds and the fresh peeled drug pounded to a soft mass to stop bleeding from cuts and wounds.

It is said that the Canadian Indians called the fungus "Wabadou" and used it as a medicine extensively. Early settlers of Ontario and Quebec used it as a substitute for hops in the making of yeast and for tonic brews. (43)

#### VIII. Active Constituents and the Preparation of Agaric Acids and Their Uses.

Agaric Acid, or Agaricin, "Agaricine", Agaricinic Acid, or Laracic Acid has been officially described in many pharmacopoeias: German, French, Swiss, English, Italian, and Japanese, and has been found in several editions of New and Non-Official Remedies.

The German Pharmacopoeia of 1910 gives the following formula:



Agaric Acid or Agaricin is now considered the principal active constituent of Agaric. Its purest form, according to the German Pharmacopoeia 1910, is the beta-resin which is a tribasic plant acid occurring as one of the three white resins in the fungus.

Agaric acid is an odorless, white amorphous or crystalline powder which melts at 140° C.; sparingly soluble in water, forming with 50 to 100 parts a gelatinous solution; soluble in hot water with foaming, but deposits upon cooling; soluble in 130 parts of cold and 10 parts of hot alcohol; sparingly soluble in ether and chloroform, but soluble in potassium hydroxide solution and in

ammonia water. It forms water soluble salts with the alkaline earth hydroxides, but insoluble salts with those of the heavy metals (30).

The 1921 edition of New and Non-Official Remedies states that it is used to arrest the secretion of sweat in colliquative sweats, but that the action is not lasting; that it paralyzes the peripheral nerves of the sweat glands and that it is one-twentieth the strength of atropine as an anhydrotic for which it is preferred as it does not influence the other secretions (29).

The single dose is given as 0.03 gm. ( $\frac{1}{2}$  grain) and the daily dose -0.1 gm. ( $1\frac{1}{2}$  grains) which should not be exceeded because of its toxicity (29).

Pure agaric acid or beta agaricin is obtained as follows: First, extract the powdered agaric with 95% alcohol. Second, upon evaporating the solution to about one-third its original volume, three white resins precipitate and a red colored resin stays in solution and is removed by filtration. Third, the white resins are treated with one-half normal alcoholic potassium hydroxide solution which dissolves the alpha-resin, leaving the beta and gamma resins as a residue; these are removed by filtration. Fourth, the beta compound forms a water soluble salt with potassium, which is extracted with water, leaving the gamma resin which is not soluble in water. Fifth, the aqueous solution containing the water soluble potassium agarate is treated with barium chloride which precipitates the agarate radicle as barium agarate which is insoluble in water. Sixth, this is filtered off and dissolved in boiling dilute alcohol and the agaricin freed by sulphuric acid.



Seventh, the agaricin precipitates from the alcoholic filtrate upon cooling and may be further purified and crystallized from thirty percent alcohol if desired (10). The beta-resin is considered the most active of all the resins contained in the drug, altho it seems evident that they all contribute to the anhydrotic action in some degree. Experiments by oral administration prove that each of the resins is laxative and cathartic.

The yield of the various resins from both the foreign and domestic drug was found to be in exact proportion to the total resin content of the drugs from the two sources.

The average percentages of resins calculated upon weight of drugs from several analyses were: red resin 38%, white resins 40%. The average percentage of white resins in the drug which was found to be soluble in hot 60% alcohol was 14.8% , which yielded alpha resin 9%, beta 3%, gamma 2%; the remainder of the 40% white resins, soluble in hot 60% alcohol, gave neither alpha, beta nor gamma resins. All the calculations are based upon the crude drug with 78% total alcoholic extract.

The white resins are all soluble in sodium hydroxide solution, forming the water soluble salts of sodium agarate.

#### IX. Pharmacodynamics of Agaric Acid and its Sodium Salt.

Agaric Acid being an irritant when injected subcutaneously and insoluble in the ordinary solvents, a water soluble salt with sodium was formed from pure Agaric Acid or beta-agaricin for intravenous and other uses by the author as follows:

Combining weights of sodium hydroxide and Agaric Acid were each dissolved in 95% alcohol and the first solution added

to the latter when a copious white precipitate of sodium agarate was thrown down; this was heated to boiling, filtered off and washed free from impurities with boiling alcohol and dried at 85° C. This sodium salt was found to be soluble in less than twenty parts of water and sparingly soluble in ether and chloroform.

Sodium agarate was added in quantities of .001, .002 and .004% to ordinary Ringer solution, but was found impracticable as the agarate radicle was soon all precipitated as a flocculent precipitate by the calcium, forming an insoluble calcium soap. Physiological salt solution (0.9%) was then used and found to be more satisfactory, altho the solution frothed readily and settled out upon long standing. These solutions were used for drip, intravenous and perfusion methods. (41)

Drip and perfusion experimental methods with various percentages were used on frogs. The frogs were pithed in the brain, the heart and vagi exposed. In some cases levers were attached to the apex of the ventricles and to either right or left auricle to show the rhythm or action. From .002 to .004% solutions seemed to give the best results, which were evidenced first in stimulation and then in a slowing of the heart. Small percentage solutions of atropine sulphate did not seem to change the rate of slowing but 0.1% solution of pilocarpine nitrate dripped upon the heart first slowed and then stimulated the heart and antagonized the slowing. It would thus seem that sodium agarate acts in some way upon the heart muscle, but does not act directly upon the vagus.

Turtles were then used and were found to be more satisfactory to work with than frogs, with practically the same results. Respiration in the turtles seemed to be stimulated, and the vagus did not appear to be affected directly.

Hemolysis experiments were tried and compared, using 0.5% solutions of sodium agarate and saponin in 0.9% salt solution, with various percentages of fresh dog blood. The solutions were placed in blood tubes in an incubator and kept at 30°C., and showed hemolysis in from one-half to one hour. Sodium agarate had a more pronounced hemolytic action than saponin in these percentage solutions, determined by the depth of color in the laking. (20) (28)

Experiments upon blood pressure and the effect upon the vagus of sodium agarate were tried upon dogs which had been anaesthetized in the usual way. After taking normal blood pressure tracings, they were injected in the femoral vein with 1/12, 1/6, 1/2, 1 and 2 grains respectively of sodium agarate, and blood pressure noted, with the vagus stimulated from time to time to see if the same showed paralysis. (20) (41)

Primary effect upon blood pressure was stimulation and secondary was lowering, with no perceptible effect upon the vagus.

Cats were anesthetized and blood pressure records taken before and after injection of agaric acid in the femoral vein. Blood pressure was first slightly raised and then lowered. Pads upon the foot seemed to become dry and less pink than before injection. The sciatic nerve of the left leg over the hip was exposed, ligated and cut and stimulated distally electrically. No sweat was evidenced upon the pads after the injection of agaric acid in the femoral vein, but the pads regained normal color as soon as stimulation ceased, showing some dilation effect. It would seem from these experiments that agaric acid and its salts act peripherally and not centrally upon the nerves of the muscles, paralyzing

in some manner the nerves of the muscles of the sweat glands. (28) Atropine, for which this drug is to be preferred, does not have this selective action but exerts a depressant effect on the endings of the autonomous nerves and thereby checks the secretions of all true glands of the body, with the exception of the mammary glands and the kidneys, which are not supplied by autonomous nerves. (27) (19) (20) (21) (22) (23) (24) (25) (26) (28). Experiments with pure agaric acid from both the foreign and domestic drug gave no perceptible differences in results.

#### X. Old and New Formulas and Suggestions

Agaric and Agaric Acid are being used in various formulas by reputable pharmaceutical manufacturers. In the N.F. V Agaric is an ingredient in Antiperiodic Pills, Antiperiodic Pills with Aloes, Antiperiodic Tincture, and Antiperiodic Tincture with Aloes.

The following formulas are suggested:

##### For Bromidrosis:

R Agaric, in fine powder	5.0 gm.
Salicylic Acid, in fine powder	3.0 gm.
Boric Acid, in fine powder	10.0 gm.
Talc, in fine powder	87.0 gm.

##### M. ft. Dusting Powder.

Sig: Apply as a dusting powder to the feet after washing with soap and warm water and drying.

##### As an Anhydrotic, Antiseptic, and Deodorant:

R Agaric Acid	0.75 gm.
Boric Acid	1.00 gm.
Alcohol (95%O qs.	100. cc
Color and perfume qs.	

##### M. ft. solution.

Sig: Apply to parts with absorbent cotton or soft cloth. For exhaustive sweats sponge the body about an hour before the expected sweat.

## XI. SUMMARY

The fungus plant found growing in Montana, and generally referred to as *Fomes laricis*, is identical with the species official in the N.F. V as *Polyporus officinalis*.

The conk or fruiting body of the Montana plant is similar in appearance, but is considerably larger than the average foreign drug. The active resinous constituents are present in larger quantities, but are the same and exert identical physiological actions.

A sufficient quantity of fine quality drug to supply the American markets is to be found growing in western Montana and adjoining forests.

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